

Professional internship for the MASTER 2 « Biologie Intégrative »

Parcours : Ecologie comportementale, Biodiversité et Evolution

**Artificial nest boxes project for the conservation of
the critically endangered Blue-Throated macaw
(*Ara glaucogularis*).**



Place of internship:

Asociación Civil Armonía

Blue-Throated macaw conservation
program

Loro Parque Fundación

Trinidad, Beni Department, Bolivia



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Acknowledgements

Firstly, I'd like to thanks Bennett, the executive director of Armonia who allowed me to do this internship in Bolivia with Armonia and to realize one of my dream to see parrots in their environment.

Then I'd like to thank Gustavo and Tjalle, the two coordinators of the Blue-Throated macaw conservation program who welcomed me in the program, gave me good advices and helped me in my work.

I'd like to thank René, Rosario and their son Luis for their help, kindness and a lot of other things that helped me to have a perfect trip at the reserve.

I also want to thank Rudy, biologist of the BTM program who send me a lot of informations about the monitoring and who always be there to help me during numerous trips.

I'd like to thank German and Daniel who helped me to do my VISA and also for their kindness.

I also thank César (Cachupo), Daniela, Miguel and Hernan for their help during my work.

Finally, I want to thank my family and my friends who were always there to help me to organize my trip or when things were difficult in Bolivia.

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Introduction

When we talk about biodiversity, one of the main topics is about species extinction. Today, researchers characterize these extinctions as the 6th mass extinction in the world. Disappearance of species is faster than ever, about 100 times upper than before (Ceballos & al. 2015). This explosion of the extinction rate is mainly due to habitat losses and degradations caused by human's activities (Soulé & al. 1986, Kerr & Currie 1995, Lande & al. 1999, Hoekstra & al. 2005). At this time, the problem is that these human's activities affect natural population sizes. Threatened species populations become smaller and more isolated; so they are highly subject to genetics, environmental and demographic stockasticity. That makes them more vulnerable against extinction risks (Gilpin & al. 1986, Hanski & al. 1996, Hedrick & al. 1996). Then, more and more species become threatened all over the world and this problem affects all the group of animals: mammals, fishes, amphibians, reptiles (Ferrer & Negro 2004, Casey & Myers 1998, Stuart & al. 2004, Gibbons 2000).

The group of Birds isn't an exception of this observation: more than 1220 birds species have been described as threatened on the 10 000 existing, whether 12% of birds according Birdlife International, which leads researches about birds for the IUCN's red list. On the 1220 threatened species, 192 are considered as "critically endangered". Psittacidae's family is one of the most threatened birds' family in the world: on the 356 species identified, 30% would be threatened (IUCN 2013). In Neotropical countries, lots of psittacidae's family members face decline of their populations and are threatened because of habitat losses, illegal pet trade and the use of their feathers to traditional clothes (Juniper & Parr 1998, Snyder & al. 2000, Forshaw 1989). Furthermore, Psittacidae's life history makes them more vulnerable to environmental perturbations and poachers. In fact, psittacidea breed really slowly in nature. So, when their populations decline, it's difficult for them to recover their initial population size. They stay at low size during long time and this is a precarious status for the survival. Moreover, they are food specialist species, so if their main aliment disappear, this is the whole species that is threatened. Finally, habitat losses have a huge impact on nesting sites. Like for food, if nest sites are not available, species can't breed (Collar 2000).

In the Psittacidae family, more than 10 species are considered as “critically endangered” according to the IUCN. This is the case for the Blue-Throated macaw (*Ara glaucogularis*), an endemic species of Bolivia whose population doesn't exceed 500 individuals in the wild. At this time, Asociacion Armonia, a birds' protection Bolivian NGO, leads a vast conservation program of the Blue-Throated macaw in its environment. This program includes scientific researches, census of population, education. Armonia has also created a reserve called “Barba Azul Nature Reserve” dedicated to the protection and the conservation of the Blue-Throated macaw where the biggest group lives. This is a sanctuary for this macaw and allows Armonia to study this relatively unknown species.

The Blue-Throated macaw is a secondary cavity nesting bird which means this macaw requires existing tree cavities for its reproduction. Obligate secondary cavity nesting birds are highly sensitive to habitat degradations (Cornelius et al. 2008), particularly degradation targeting mature trees which contain most potential nesting cavities. Populations of secondary cavity nesters are often limited by the availability of suitable cavities (Berkunski & Reboresda 2009; Brawn & Balda 1988, Martin & Li 1992, Newton 1998). The Blue-Throated macaw suffers from the loss of older motacú palm tree (*Attalea phalerata*), due to cattle ranching, which is its main cavity nesting tree. This parrot is also affected by competition for cavities against Blue-and-Yellow macaw (*Ara ararauna*), Toucan (*Ramphastos toco*), Black-bellied whistling duck (*Dendrocygna autumnalis*) or Barn owl (*Tyto alba*). And finally, when a pair of Blue-Throated macaw is nesting, it has to face predators like coati (*Nasua nasua*), Black-howler monkey (*Alouatta pigra*), Southern Caracara (*Caracara plancus*) or snakes' species. So, this macaw is facing a lot of problems to breed. This is a huge trouble because of the lack of nesting sites, its population remains small; so its population can't grow. For any given species, nest site selection is especially important because failed reproductive efforts may retard population growth (Ricklefs 1969, Caughley 1977). Moreover, Blue-Throated macaw is distributed in two potentially isolated populations that can't mix with each other. For endangered species or geographically isolated populations, reproductive failures may also increase the probability of extinction (Loiselle and Hoppes 1983, Sieving 1992, White & al. 2005a). Resource selection by an animal can be regarded as hierarchical or ordered (Johnson 1980). Within this hierarchy, however, the selection of an appropriate nest site is arguably one of the most profound choices affecting an individual's fitness,

and ultimately, species persistence (Walsberg 1981, Li and Martin 1991, Carey et al. 1997, White et al. 2001). So, nest selection is the most important thing for the conservation of this macaw and for the expansion of its natural population.

That's why two nest boxes programs have been established by Armonia to face the lack of natural cavities and also to raise the reproductive efforts of this species. This type of project is often used for the conservation of bird species. Nest boxes provision is a frequent intervention used to address concerns over nest site limitation in cavity nesting birds (Roberts & al 2014). However, the widespread use of nest boxes can halt population declines or can considerably increase a local population, especially in environments where cavity-forming trees are missing (Lambrechts & al 2012). Many benefits can be associated with the use of nest boxes: it can facilitate access to nest content and therefore allow routine monitoring and handling of eggs or nestlings (Smallwood & al. 2009, Brommer & al. 2003, Tella & al. 2000). Nest's characteristics usually mimic the natural nest hollow of the target species (Olah & al. 2014). Armonia's nest boxes programs take place in two different locations corresponding to the distribution of the two subpopulations: the first is located south of Trinidad, near the city of Loreto and the second, north of Trinidad, in the Barba Azul Nature Reserve. The former program has been set up in 2005 including 60 boxes this year. The latter, at the Barba Azul Nature Reserve, began in 2014 following the extension of the reserve and the acquisition of peaceful forest islands on which 20 nest boxes have been placed. Nest boxes are placed in area where Blue-Throated macaws are usually seen or where Blue-Throated macaw's natural nests failed in the previous years. These nest boxes have to be monitored during the breeding season to follow potential nesting attempts. Monitoring consists in checking up nests several times from December to May. My work within Armonia was to conduct the monitoring of the two nest boxes programs.

This year, the monitoring of the Blue-Throated macaws' nest boxes has been done for the 1st time at the "Barba Azul Nature Reserve" and for the 10th consecutive years in the southern population. In this report, we will study monitoring's results of this year and examine results of the two previous years for the southern program. So, different questions may be asked:

- **Did Blue-Throated macaws use the new nest boxes at the reserve?** Here we think that they didn't breed in the nests because they need time to adjust to these boxes.
- **Did they still use next boxes in the south?** In the previous years, some pairs used successfully the nest boxes, so we think that this was the case this year, with some new chicks fledging from these boxes.
- **Have some nests been re-used by Blue-Throated macaw this year?** Hard competition for cavities and low number of them will press Blue-Throated macaw to re-use former successful nest boxes.
- **What are the reproductive parameters (breeding period, nesting location, number of eggs laid) of the Blue-Throated macaw in the area of Loreto?** In general, Blue-Throated macaws nest from December to March and usually lay 2 to 4 eggs.

Nest boxes programs are really important for the recovery of this species in the wild, enhancing population size and because they bring helpful data about breeding biology which remain today largely unexplored (Berkunsky & al 2014). These data will have important conservation applications optimizing nest boxes program to help the recovery of the Blue-Throated macaw.

Association Armonia

Founded in 1993, Armonia is a Bolivian NGO dedicated to the protection of Bolivian birds and their environment. Its main aim is to fight against birds' extinction in the Bolivian territory. Armonia's conservation actions are primarily based on scientific studies with the involvement of communities in the respect of their cultures. Armonia tries to protect birds while improving the living conditions of populations. Since 1996, Armonia is the Bolivian partner of Birdlife international, the international bird protection's NGO. Armonia is also partner of lots of international organizations like the Loro Parque Foundation, Bird Endowment, the American Bird conservancy and World Land Trust which all aim to protect the biodiversity on earth. The main office of Armonia is located in Santa Cruz de la Sierra, the economic capital city of Bolivia. This office possesses the best bird's book collection of the country. The best data bases about birds is also the property of Armonia. All of these facts show that Armonia is a leader in bird

conservation in Bolivia. Scientifically, Armonia is involved in 18 conservation projects and programs in whole Bolivia of which conservation program of the 5 critically endangered birds of Bolivia: the South bolivian horned curassow (*Pauxi unicornis*), the Sira curassow (*Pauxi koepckeae*), the Royal cinclods (*Cinclodes aricomae*), The Red-fronted macaw (*Ara rubrogenys*) and the Blue-throated macaw (*Ara glaucogularis*).

Armonia choose to focus its works on birds in a states where the biodiversity is important and where lots of different species are endangered, but why birds? Except their spectacular colors and their ability to adapt on different environment, birds are really good indicators of environmental health because of their sensibility to environmental changes. In the actual biodiversity crisis, birds are the most “visible” indicators of these changes. So, birds’ species-rich geographical areas are important for biodiversity in general. Finally, birds are important indicators for priority conservation areas in the world.

For more than 20 years, Armonia has encountered great successes in bird conservation:

- Involved in the “Important Birds Areas (IBA’s)” program.
- Armonia actions allow the reduction of poach and illegal traffic of the two critically endangered macaw species: the Blue-throated macaw and the Red-fronted macaw.
- The Red-fronted macaw lodge has been created for the protection of this species. Lots of ornithologists come there and all the incomes go to communities.
- 3 reforestation projects were committed across the country.
- An 11 000 hectares reserve has been created in the north of Bolivia for the conservation of the Blue-throated macaw.

Even if Armonia actions are focused on birds, others species can benefit from these actions. In fact, protection of birds’ environment will also protect mammals, reptiles, insects or amphibians, so we can say that birds play the role of “Umbrella species” (Roberge, 2004).

To conclude, Armonia is an important Bolivian NGO which tries to protect endangered species across the country while involving local communities. Armonia is



Head difference between a Blue-and-Yellow macaw (left) and a Blue-Throated macaw (right)



A pair of Blue-Throated macaw (background) with a pair of Blue-and-Yellow macaw (foreground) in the Barba Azul Nature Reserve (picture taken by Nicolas Lefrique)

also leading important communication and sensitization programs to involve more and more people including new generations in a country where ecology and environment protection are not priorities.

The Blue-Throated macaw

The Blue-Throated Macaw (*Ara glaucogularis*) is a parrot of the Psittaciforme's order and the Psittacidae's family. This relatively unknown species has been rediscovered in 1992 after an expedition in Bolivia (Jordan & Munn, 1993). The lack of information about the ecology of this species is due to this belated rediscovery. The Blue-Throated macaw is considered as one of the most threatened bird species in the world according to Birdlife International. It has been placed in the "critically endangered" category of the IUCN red list (IUCN 2013). According to recent census, the population size is about 350 individuals, but this number can be under-estimated because of the difficulties to inventory this species (Loro Parque Fundacion 2004). Estimations speak about a population between 350 and 500 individuals remaining. This species is protected since 1986 by the national legislation of Bolivia and also by the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). Moreover, this parrot is on the "Annex II" of the Washington's convention which also protects it.

Physically, the Blue-Throated macaw is medium-sized with 85 cm for 600-800 g. There isn't sexual dimorphism for this macaw. Its blue and yellow colors make it looking like the Blue-and-Yellow macaw. Differences between them are the colors of their throat: blue for the Blue-Throated macaw and black for the other. The latter is also bigger.

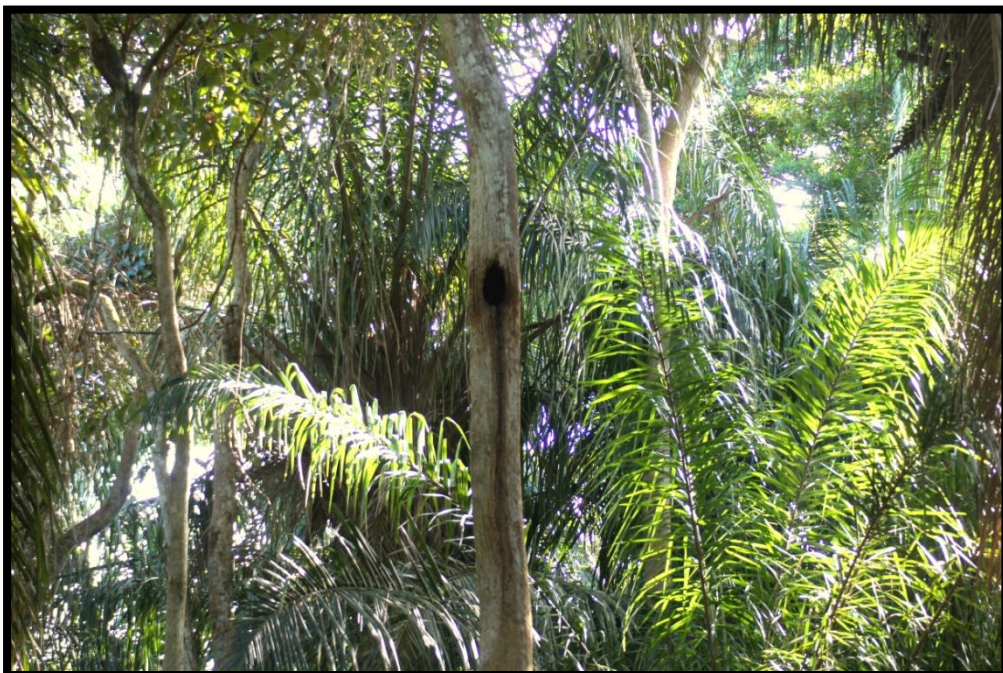
The Blue-Throated macaw is endemic of the "Llanos de moxos" area in the Beni Department, Bolivia (Jordan & Munn, 1993). This macaw inhabits seasonally flooded savannahs fragmented by forest islands (Hanagarth, 1993). The rainy season is from November to May. This species feeds on the mesocarp of motacu palm tree's fruit (*Attalea phalerata*) which is available year round. This tree represents about 80% of the forest island and is essential for the Blue-Throated macaw for food and nesting cavities.



Beni Savannah with a gallery forest. Typical habitat of the Blue-Throated macaw (picture taken by B.Hennessey).



Motacu forest and motacu fruits (Pictures taken by Nicolas Lefrique)

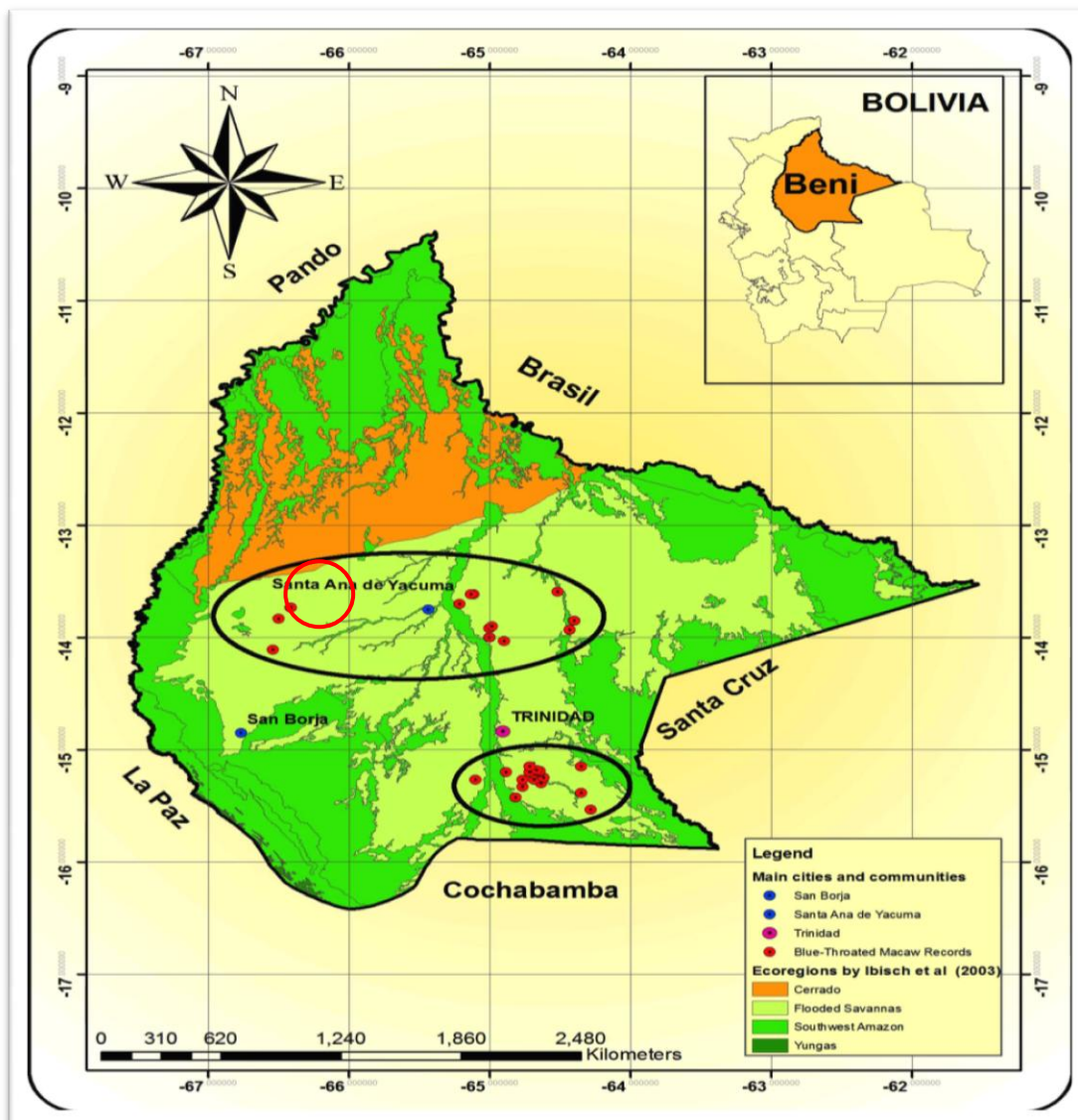


Natural nest cavity which can accomodate Blue-Throated macaws (Picture taken by Nicolas Lefrique)

The motacu isn't exclusive for the Blue-Throated macaw because observations of this species feeding with *Acrocomia aculeata* and *Mauricia flexuosa* fruits have been recorded (Bueno 2000). The mesocarp is an essential contribution in lipids and carotenoids for its metabolism (Yamashita & Machado, 1997).

For nesting, the Blue-Throated macaw uses cavities in different palm trees' species, in their snag form: *A. phalerata*, *A. Aculeata*, *M. flexuosa*, *A. macrocarpa* and *C. spruceanum* (Yamashita & Machado, 1997, Herrera & al. 2007). As mentioned in the introduction, this macaw is a secondary cavity nester, as numerous of parrots (Monterrubio-Rico & Escalante-Pliego 2006), meaning he needs pre-existing cavities to nest. So, its reproduction success is closely linked with the availability and quality of cavities (Hesse & Duffield 2000). Moreover, The Blue-throated macaw is a monogamous parrot which will live in pair with only one partner. This is also a limiting factor for its recovery in the wild (Forshaw 1973, Snyder et al. 2000). Its breeding season begins in November with the start of rainy season and ends usually in January/February. But it's not uncommon that this breeding season extends until March or May (Hesse & Duffield 2000). Breeding season is linked with the period when fruits are abundant, which guarantee optimal conditions for the feeding of young. Female lays from 2 to 4 eggs. Eggs need 25-26 days of incubation to hatch. Chicks will fly about 90 days after their hatching (Bueno 2000). Both parents take care of the young. Sexual maturity is reached at the age of 5 years (Bueno 2000, Voss 2005). A Blue-Throated macaw can live about 60 years in nature.

In addition to the lack of natural nest cavities for breeding, the Blue-Throated macaw has to face many other threats. As for the majority of the biodiversity today, degradation and destruction of habitat due to cattle ranching, expansion of roads or anthropogenic activities have a huge impact on this parrot. Fragmentation of its population is also a problem (Gonzalez 2003). Difficult climatic conditions as floods, storms or El Nino's events can destroy nesting sites and kill young. Moreover, in the Beni department, tail's feathers are used in the confection of traditional clothes. Huge quantities of feathers are needed and parrot likes macaws are always impacted by these cultures. Finally, one of the major threats to Blue-Throated macaw is poaching for pet trade. Between the 80's and the 90's, this macaw has faced population decline because of



Distribution of the Blue-Throated macaw in the Beni area, North of Bolivia (reference: R. Stem, "Population Viability Analysis of the Blue-Throated Macaw (*Ara glaucogularis*) Using Individual-Based and Cohort-Based PVA Programs", 2012). In red is the location of the Barba Azul Nature Reserve.



Some of the forest islands along the Rio Tiniji where nest boxes have been placed (picture taken by B. Hennessey)

poaching. Illegal trades are still done: for example, 2 Blue-Throated macaws were recently seen on a market in Bolivia (Herrera & Hennessey, 2008).

Recently, after many years of hard work, the Bolivian government has decreed the Blue-Throated macaw as a national natural heritage species. This is a new hope for the recovery of the species and also a strong sign of realization from the government. This is a reward for the work of all field's NGOs like Armonia.

Material and methods

Study sites

The Blue-Throated macaw is endemic to the “Llanos de Moxos” region in the Beni department, Bolivia. Trinidad is the main city of this region. The two nest boxes programs take place in this department. Each program is located in one isolated subpopulation of the species. The first program is in the area of Loreto, Marban province, south of Trinidad. A total of 60 nest boxes are present in the area of 5 different private ranches: 24 nests in Esperancita (Esp), 4 in La Tranca (LT), 15 in Santa Rosa (SR), 7 in La Asunta (As) and 10 in Cantina (Cant) (**Annex1**). To access these ranches, the ride was done by horseback. In the two previous years of the program (2012-2013 and 2013-2014 breeding seasons), two more locations owned nest boxes: Villa Lupita (VL) and Getafe (Get).

The second program is located at the “Barba Azul Nature Reserve”, north of Trinidad, West of the Rio Mamoré. This reserve was created in 2008 and in 2014 was expanded to reach 11 000 hectares. The reserve is a mosaic of different habitats: tropical grasslands, motacu dominated palm islands, gallery forests, surrounding savannahs and cerrado type vegetations. The largest known congregation of Blue-throated Macaws occurs here. The protection of two large gallery forests will ensure food resources for the Blue-Throated Macaws, while the smaller forest islands will protect remote roosting sites. At the reserve, 20 nest boxes have been placed last year on 6 forest islands located along the Rio Tiniji, north of the Reserve: 4 nests on the 3B island, 4 on the 4B, 4 on the 5b, 3 on the 6B and 7B, 2 on the 8B. 2 others nests are present on the “Isla Maneche”, south of the reserve (**Annex2**). The ride to access nests was done by horseback, canoe or motorboat.



Monitoring of a nest box. We can have access to the interior thanks to the small door. (picture taken by René Carthagena)



Nest box places on a tree, in the Barba Azul Reserve (Picture taken by Nicolas Lefrique)



Nest boxes design: 10 x 10cm in diameter (left) Vs 12 x 25 cm (right) (Pictures taken by Nicolas Lefrique).

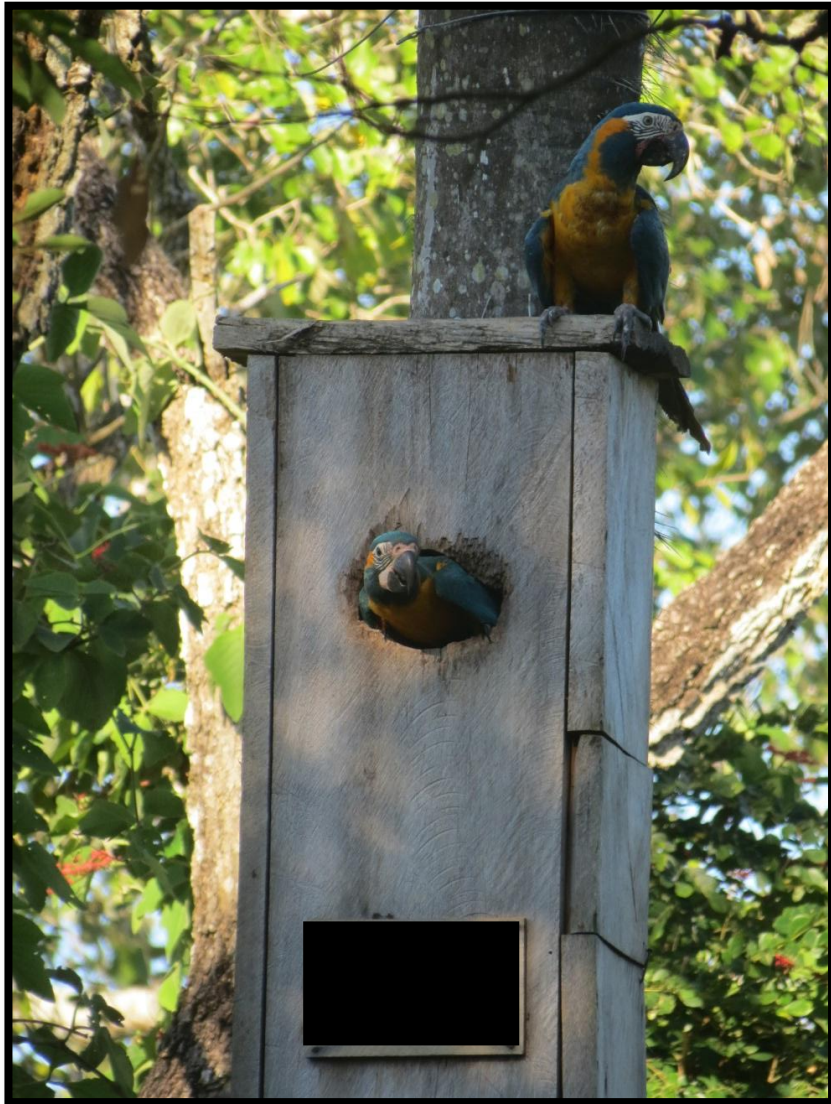
Monitoring technique

For the program in Loreto, monitorings were conducted from December the 7th to May the 8th. Each monitoring lasted 7-8 days and was done every 2 weeks. At the reserve, two monitoring sessions were conducted: one in March (the 9th to the 11th) and the other in May (the 19th to the 21th) and each lasted 2-3 days. Difficulties in the establishment of the method to access the islands and also a strong rainy season didn't allow us to do more session. This didn't matter because it was the first year for this monitoring. Then, nests were reached with a wooden ladder and we noted if something was inside. Activity around the nest was also observed to see if Blue-Throated macaw was seen in the area. Observations of any tracks or feathers were also described. Pictures of eggs and young inside nests were taken. When there were Blue-Throated macaw eggs in a nest, nest visits became more regular to avoid the loss of a young. In some case, the feeding of a young could be done if the mother didn't take care of it. The number of artificial nests monitored each year varied as new nests were added, old nests were moved, trees containing nests fell down, and old nests were abandoned by the birds. When young were present in nest, we lowered them to the ground in buckets to manipulate them and put a ring on their claw (Nycander et al. 1995).

Nest boxes design

Artificial nests were created initially as a rectangular box 1m long x 30 cm wide. Boxes are made with woods "Ochoo" (*Hura crepitans*) and "Palo Maria" (*Calophyllum brasiliense*). The boxes are generally placed on "Totai" (*Acrocomia aculeata*) and "Motacú" (*Attalea phalerata*) palm trees at a height of 5m above the ground.

This year, all boxes have an entrance hole of 10 x 10cm. Only the two nest boxes on the "Isla Maneche" at the reserve have an entrance ovoid of 12 x 25cm. Nest boxes try to mimic natural cavities to be attracting for Blue-Throated macaw. Each year, Armonia tries to create better boxes which attract more Blue-Throated macaw than other birds' species, that's why there is a difference of the diameter. The nest is also equipped with a small door facilitating the access and manipulations of chicks in the nest. For the 2012-2013 breeding season in Loreto, nest boxes' entrance hole was 12 x 12cm in diameter whereas for the 2013-2014 breeding season, entrance hole was 10 x 10cm in diameter like this year.



A pair of Blue-Throated macaw using a nest box in the area of Loreto



Another Pair of Blue-Throated macaw using a nest box in the area of Loreto. The mother is watching inside to see her babies.

Results

A total of 178 nest boxes have been monitored during three breeding seasons in the area of Loreto. This represents a mean of 59 nests monitored each year.

Monitoring in Loreto, 2012-2013 and 2013-2014 breeding seasons

➤ 2012-2013

This year, on the 58 nest boxes monitored, 22 were occupied by birds: 15 boxes were used by Blue-and-Yellow macaws, 2 by Black-bellied Whistling-ducks and 1 by Muscovy duck (*Cairina moschata*) and 4 by Blue-Throated macaws.

Species	Number of occupied nest boxes	Location of the nest boxes used
Blue-and-Yellow Macaw (<i>Ara ararauna</i>)	15	7 SR, 5 Esp, 1 Cant, 1 As, 1 LT
Blue-Throated macaw (<i>Ara glaucogularis</i>)	4	2 Esp, 1 Cant, 1 SR
Black-bellied Whistling duck (<i>Dendrocygna autumnalis</i>)	2	2 SR
Muscovy Duck (<i>Cairina moschata</i>)	1	1 LT

Most of the occupied nest boxes were present in the ranches called “Esperancita” and “Santa Rosa”. 1 nest box was used in “Asunta”, 2 in “Cantina” and 2 in “La Tranca”. Blue-and-Yellow macaw was the most common bird find in nest boxes.

For the Blue-Throated macaw, the results of the study are outlined bellow (N° of nest, location, coordinates and description):

- **Nest KJ: Santa Rosa (15°17'45.06"S; 64°38'47.88"W).**

3 eggs were laid in early December but only 2 eggs hatched at the end of the month. The two young Blue-Throated macaws successfully fled from the nest at the end of March.

- **Nest CZ: Cantina (15°12'46.08"S; 64°40'40.08"W)**

3 eggs were laid in mid-January but only 2 eggs hatched in the early February. The two young successfully fled from the nest in mid-April.

- **Nest GA: Esperancita (15°11'29.07"S; 64°43'06.01"W)**

4 eggs were laid at the end of December but only 3 hatched in the early January. The three chicks successfully fled from the nest at the end of March.

- **Nest BL: Esperancita (15°11'41.09"S; 64°43'21.04"W)**

3 eggs were laid in the end of December and all hatched in the early January. The three young successfully fled from the nest at the end of March.

4 nest boxes were used by Blue-Throated macaw from which 13 eggs were laid by females. 10 eggs were laid in December (77%) and 3 in January (23%). On these 13 eggs, 10 young successfully hatched (77% of eggs laid): 2 in December (20%), 6 in January (60%) and 2 in February (20%). From these 10 eggs, all the young successfully fled (100% of eggs hatched): 8 at the end of March (80%) and 2 in mid-April (20%). On the 4 nest boxes used, 2 were located in Esperancita (50%), 1 in Cantina (25%) and the remaining in Santa Rosa (25%).

➤ **2013-2014**

This year, on the 60 nest boxes monitored, 22 were occupied by birds: 10 were used by Blue-and-Yellow macaws, 7 by Black-bellied Whistling-ducks and 1 by Muscovy duck (*Cairina moschata*) and 4 by Blue-Throated macaws.

Species	Number of occupied nest boxes	Location of the nest boxes used
Blue-and-Yellow Macaw (<i>Ara ararauna</i>)	10	4 SR, 1 Esp, 2 Cant, 1 As, 2 Get
Black-bellied Whistling duck (<i>Dendrocygna autumnalis</i>)	7	3 Esp, 1 Cant, 3 LT
Blue-Throated macaw (<i>Ara glaucogularis</i>)	4	2 SR, 2 Esp
Muscovy Duck (<i>Cairina moschata</i>)	1	1 As

Most of the occupied nest boxes were present in the ranches called “Esperancita” and “Santa Rosa”. 2 nest boxes were used in “Asunta”, 3 in “Cantina”, 3 in “La Tranca” and 2 in “Getafe”. Blue-and-Yellow macaw was again the most common bird find in the nest boxes.

For the Blue-Throated macaw, the results are outlined below (N° of nest, location, coordinates and description):

- **Nest PBA19: Santa Rosa (15°17'49.06"S; 64°38'47.08"W).**

2 eggs were laid in the early January but unfortunately they had been broken apparently by Blue-and-Yellow Macaw.

- **Nest PBA31: Santa Rosa (15°17'58.03"S; 64°37'54.05"W)**

3 eggs were laid at the end of December, all hatched in mid-January but unfortunately only two young successfully fled from the nest at the end of March. The other one died because that the tree where the nest was fixed fell off.

- **Nest PBA12: Esperancita (15°11'23.01"S; 64°43'08.08"W)**

3 eggs were laid at the end of December and all hatched at the end of January. The three chicks successfully fled from the nest at the end of March.

- **Nest PBA4: Esperancita (15°11'41.09"S; 64°43'21.04"W)**

2 eggs were laid in the end of December and all hatched mid-January. The two young successfully fled from the nest at the end of March. This nest box was already used last year.

4 nest boxes were used by Blue-Throated macaw from which 10 eggs were laid by females: 8 were laid in December (80%) and 2 in January (23%). On these 10 eggs, 8 young successfully hatched (80% of eggs laid) all in January (100%). From these 8 eggs, 7 young successfully fled from the nest boxes (88%) all at the end of March, the remaining died because of a falling tree. On the 4 nest boxes used, 2 were located in Esperancita (50%) and 2 in Santa Rosa (50%).

Monitoring in Loreto, 2015

This year, 60 artificial nest boxes have been monitored in the area of Loreto, south of Trinidad. On the 60 nest boxes, 26 were occupied by any bird species. 5 nests were used by Blue-Throated macaw. The other birds species that used nest boxes were Black-bellied Whistling duck (*Dendrocygna autumnalis*), White-eyed Parakeet (*Aratinga leucophthalmus*) and Blue-and-Yellow Macaw (*Ara ararauna*). The remaining 36 nest boxes didn't show any activity inside.

Species	Number of occupied nest	Location of the nest boxes used
Black-bellied Whistling duck (<i>Dendrocygna autumnalis</i>)	13	7 Esp, 5 Cant, 1 As
White -eyed Parakeet (<i>Aratinga leucophthalmus</i>)	6	3 Esp, 2 Cant, 1 As, 1 SR
Blue-Throated macaw (<i>Ara glaucogularis</i>)	5	4 Esp, 1 Cant
Blue-and-Yellow Macaw (<i>Ara ararauna</i>)	2	2 SR

Most of the occupied nest boxes were present in the ranches called "Esperancita" and "Cantina". 2 nests boxes were occupied in "Asunta" and 3 in "Santa Rosa". The "La Tranca" Ranch had no occupied nest. The Black-bellied Whistling duck was the most common bird find in the boxes.

For the Blue-Throated macaw, the results are outlined below (N° of nest, location, coordinates and description):

- **Nest PBA9 (RS): Esperancita (15°11'43.86"S; 64°43'23.07"W).**

3 eggs were laid in mid-February but only 2 eggs hatched in the beginning of March. Both young successfully fled from the nest in May.

- **Nest PBA35 (AA): Cantina (15°12'48.54"S; 64°40'41.76"W)**

3 eggs were laid in the beginning of December and all hatched at the end of December. The three young successfully fled from the nest in mid-March.

- **Nest PBA54 (GEN): Esperancita (15°11'30.12"S; 64°43'7.86"W)**

3 eggs were laid in mid-December and all hatched in the beginning of January. The three chicks successfully fled from the nest at the end of March.

- **Nest PBA56 (AL): Esperancita (15°11'37.50"S; 64°43'17.22"W)**

3 eggs were laid in early of December but only 2 eggs hatched at the end of the month. The Two young successfully fled from the nest in mid-March

- **Nest PBA58 (AH): Esperancita (15°11'44.64"S; 64°43'21.40"W)**

2 eggs were laid in early February but unfortunately the two didn't hatch because they were in poor conditions.

5 nest boxes where used by Blue-Throated macaw from which 14 eggs were laid by females (**Annex4**): 9 were laid in December (64%) and 5 in February (36%). On these 14 eggs, 10 young successfully hatched (71% of eggs laid): 5 in December (50%), 3 in January (30%) and 2 in March (20%). From these 10 eggs, all young successfully fled from the nest boxes (100%): 8 in March (80%) and 2 in May (20%). On the 5 nest boxes used, 4 were located in Esperancita (80%) and 1 in Cantina (20%).

Monitoring in Loreto of the 3 last breeding seasons.

A total of 178 nests have been monitored during the 3 last breeding seasons. On these nests, 70 were used by any birds species (39%): 27 used by Blue-and-Yellow Macaw (39%), 22 by Black-bellied Whistling Duck (31%), 13 by Blue-Throated Macaw (19%), 6 by White-Eyed Parakeet (9%) and 2 by Muscovy Duck (2%).

For the Blue throated macaw, 13 nest boxes were used during the 3 breeding seasons: 4 in 2012-2013 and 2013-2014, 5 in 2015 (**Annex3**). From these 13 nests boxes, 37 eggs were laid by females: more than half (69%) of the clutches had three eggs, 23% had two eggs and 8% had four eggs. Eggs were laid between December and February: 27 eggs in



A female Barn owl (*Tyto alba*) inside a nest box with her two eggs on the « Isla Maneche » (Picture taken by Nicolas Lefrique)



A female Black-bellied Whistling duck with her numerous eggs inside a nest box on a Rio Tiniji's island (Picture taken by Nicolas Lefrique)

December (72%), 5 in January (14%) and 5 in February (14%). So, the mean clutch size here is 2,9 with a range of 2 to 4 and a mode of 3 eggs per clutch.

On These 37 eggs laid, 28 young hatched successfully: 7 in December (25%), 17 in January (61%), 2 in February (7%) and 2 in March (7%). The average clutch size at hatching is 2,15 with a range of 2 to 3. Hatching success was 76%. Hatching failure (7 eggs/9) and predation (2 eggs/9) was the two causes of egg losses. In most nests all eggs hatched (46%, n = 6) or just one egg failed to hatch (38%, n = 5). In only two nests, the 2 eggs present failed to hatch (15%). 27 young successfully fled from the nest boxes: 23 in March (72%), 2 in April (14%) and 2 in May (14%). The average clutch size at fledging was 2,08 fledglings per clutch (range: 2–3; n =11 nests). Fledging success were 96% of the young hatched and 73% of the eggs laid. Only one young died because of the tree where the nest fell off. The nestling period lasted approximately three months with a range of December to May. On the 13 nest boxes used by Blue-Throated macaw, 8 were located in Esperancita (62%), 3 in Santa Rosa (23%) and 2 in Cantina (15%).

If we pool all nests, of 37 eggs (n= 13 nests), 9 eggs were lost during the incubation period and only 1 young was lost during the nestling rearing period. Between 2012 and 2015, a total of 11 nestlings of Blue-throated Macaw successfully fledged, meaning an average of 3,7 nestlings per year fledged from all nests boxes during the study period.

Monitoring at the “Barba Azul” Nature Reserve (BANR)

At the reserve, 22 artificial nest boxes were monitored: 20 on Rio Tiniji’s Islands and 2 on the island called “Isla Maneche”. On the 22 nest boxes, 8 were used by birds species (36%): 7 were used by Black-bellied Whistling ducks (*Dendrocygna autumnalis*) and 1 by Barn owl (*Tyto alba*). 3 nests were used by wasps (*polistes spp.*). The remaining 11 nest boxes were not used during this year. Blue-Throated macaw didn’t use nest boxes at the Barba Azul Nature Reserve but we have seen few of them roosting on islands 3B and 4B during the monitoring. On islands 6B, 7B and 8B, macaw’s feather and also motacu’s consumed fruit have been observed reflecting a recent presence of Blue-Throated macaw on these islands. Island 5B didn’t show any macaws’ activity. Inside all nests, previous use by macaw wasn’t observed.

Discussion

Monitoring in Loreto

Established in 2005, the nest boxes program in the area of Loreto is today a great success for Armonia. We have seen that, on the 3 last years, an average of 9 young successfully flew from nests each year. For a subpopulation of about 100 individuals, 9 births each year are good results. By adding potential births in natural cavities that weren't monitored, we can have a good renewal of the population each year, an essential point for the recovery of the species. Between 2012 and 2015, there is no significant change in the use of nests by Blue-Throated macaw because 4/5 nests were used each year. So the difference in the entrance hole diameter had no impact on the use by this macaw. But this change in the diameter had another consequence. In fact, it excludes big birds like the Blue-and-Yellow macaw. Actually, we can see that the number of this macaw using nest boxes is decreasing over time, passing from 15 to 2 between the 3 years while Black-bellied Whistling duck and White-Eyed parakeet is respectively passing from 2 to 13 and 0 to 6. These two birds species are smaller. So we can conclude that the new hole entrance of 10 x 10cm is promoting smaller species than before. This characteristic has been established after many years of monitoring and observation of nesting competition. The aim is to decrease predation and competition of the Blue-Throated macaw against species like Blue-and-Yellow macaw or Toucan (Armonia, unpublished data). So, the entrance hole has no direct impact on Blue-Throated macaw yet, but it has an impact on the other birds species using nest boxes.

Reproductive parameters

Like other birds, the Blue-Throated macaw often lays more eggs than they raise which may act as a form of insurance in case of hatching failure or other loss during incubation (Stinson 1979). In this study, the mean clutch size was 2.9, higher than previous data for this species: 2.53 \pm 0.10 (Berkunsky & al. 2014). This is also higher than for other macaws species: 2.7 (\pm 0.08) for *A. macao* (Olah & al. 2014) and between 2.5 and 2.8 for *A. chloroptera* and *A. ararauna* (Nycander & al. 1995). Clutch sizes were similar to reported values in captive and wild population where the mode of three eggs is usual (Bessinger & al. 2008, Olah & al. 2014).

Hatching success in this study was 76%. Berkunsky & al. (2014) found a success of 72% in their study, so this is closely similar. This hatching success is also

comparable to other macaw species. In fact, the Red-and-Green macaw (*Ara chloropterus*) and the Scarlet macaw (*Ara macao*) had respectively 77% and 50% of hatching success. This Only difference is with the Blue-and-Yellow macaw (*Ara ararauna*) with 36% of hatching success (Olah & al. 2014, Nycander & al. 1995). Moreover, all eggs hatched in 46% of occupied nest. This is lower than what was previously found for the Blue-Throated macaw and other macaw species for which all eggs hatched in 61% of occupied nests (Berkunsky & al. 2014, Olah & al. 2014). For our study, clutch replacement wasn't observed in nests that failed during incubation. Second clutches are not common in wild parrots. Observations of clutch replacement have been documented only for Scarlet macaws (Brightsmith 2005). The decision of some pairs of macaws to initiate a second clutch may be linked to healthy female or food availability during the breeding period, or both (Berkunsky & al. 2014).

73% of the initiated nest gave at least one fledging. This is lower than previous observation of 89% for the Blue-Throated macaw (Berkunsky & al. 2014). This is also lower than the 88% reported value for the Hyacinth macaw (*Anodorhynchus hyacinthinus*) (Guedes 1995). But this is higher than other macaw species (between 55 and 65%) (Renton 2009). In this study, we observe 2,08 fledging per successful pair. This is similar to previous data on this macaw which was a clutch size at fledging of 2 (Berkunsky & al. 2014). Moreover, the high nestling survival observed (96%) in successful pair is probably a consequence of the intensive conservation methods used. In 3 year, only one young died because of a natural event. Human interventions allow these indices to be higher than if actions weren't made, in natural conditions.

About the reproduction timing, things are pretty clear. In most cases, the clutch initiation is done in December then the hatching takes place in January, about 25 days after. Finally, young fledge most often in March, three months after the egg laying. Breeding attempts between March and May have been observed but are more rare. These informations are in agreement with previous data (Berkunsky & al 2014, Jordan & Munn 1993). The availability of food at this time is one of the reasons for this timing.

In this study, the totality of the nesting attempts was in 3 locations: Esperancita, Santa Rosa and Cantina, with a majority in the first one. So, on the 7 locations available, just 3 were productive. Blue-Throated macaws are more present on these 3 sites. During the monitoring, adults were seen at each time on these 3 areas and not often at the

others. Moreover, Esperancita present the highest concentration of Blue-Throated macaw among the 7 locations. It was demonstrated that some parrots species prefer to breed close to each other at high density. Nesting in close proximity may improve predator detection or nesting success (Olah & al 2014, Eberhard 2002). Furthermore, Blue-Throated macaw may have selected the location because of its quality: food availability, poor predation, natural cavities. So, good habitat and proximity of nest cavities can be the two explanation of why they use nest boxes in this 3 sites rather than in the others.

Finally, during these 3 years of monitoring, there was only one nest box re-used by a successful pair from one year to another. However, re-using of successful nest boxes or artificial cavities has been previously documented both for the Blue-Throated macaw (Berkunsky et al. 2014) or other parrots' species (olah & al. 2014, Berkunsky & Reboreda, 2009, White & al. 2005). Firstly, between the first and the second year of monitoring, entrance hole have been change and this change have led to a new distribution of the nest boxes, lots of them moved. Secondly, in their study of 2014, Berkunsky & al. hypothesized that successful breeding pairs are unlikely to breed the following year. This result is really annoying for the recovery of the species but, here, it can explain why there is only one nest box re-used by successful breeding pairs. Parents appear to take care of their young for an extend period which possibly go through the following breeding season. Finally, it has been shown that breeding pairs that failed to breed in a given year are unlikely to attempt the following year (Berkunsky & al. 2014). These two last explanations are hypothesis but can easily explain why just one nest box was re-used during the 3 years study period. But we can observe that some new nest boxes used are close from those of the previous years. Maybe successful pairs may change their nest location, but they don't go far. Moreover, we have observed during these 3 years, that some nest boxes have been re-used by other birds species, most commonly by Black-bellied Whistling Duck. The re-use was from one year to another but also the same year. For exemple, in 2015, a pair of duck successfully breeds in boxes where Blue-Throated macaw and Parakeets also breed.

To conclude, our three-year study data provides more insights into the reproductive biology of the Blue-Throated macaw in the southern population, in the

area of Loreto. It provides also an evaluation of nest boxes as a potential tool for enhancing macaw conservation. In place since 2005, the nest boxes program in Loreto is actually a success for Armonia and for the recovery of the species even if hard works still remain to do to improve the program. The aim being that more and more young successfully fly from nest boxes.

Monitoring at the Barba Azul Nature Reserve (BANR).

The establishment of the nest boxes program in the BANR is really recent, nest boxes have been placed in 2014. This program provides hope for a potential nesting success for the coming years, which would be the first birth of Blue-Throated macaw on the reserve. Unfortunately, the monitoring of the nest boxes conducting this year didn't show any nesting attempt by Blue-Throated macaw. This result isn't surprising because it was predicted. In fact, this is the first year that these nest boxes are available for Blue-Throated macaw. As a clever species, this macaw learns the majority of its behaviour by observation of its parents, its congeners and its environment (Armonia, unpublished data). For example, if a young is born in a cavity of motacu, it will search for the same type of cavity to nest when it will breed. Thereby, nest boxes represent new things in the environment of the Blue-Throated macaw, it will take time for them to recognize these boxes as a safe nest cavity. We think that Blue-Throated macaws will need one or two year(s) to adjust to nest boxes, watching them to see if they're safe, trying them. We also think that Blue-Throated macaw can observe other birds' species using nest boxes. This year, Black-bellied Whistling ducks have used some of the boxes. Maybe, Blue-Throated macaws have observed them breeding inside and maybe that will drive them to do the same. Success of this program is based on the first Blue-Throated macaw pair that will use a box as a nest site. This will allow the other to understand the usefulness of boxes as breeding site. But this is the major challenge. Bennett Hennessey, the Executive Director of Armonia, said that the first birth at the reserve may save the species from extinction. So, we better understand the stake and expectations of this program.

Unfortunately, things aren't so easy. There are different hurdles for the success of this program. First, Blue-Throated macaws don't stay at the reserve the all year. During the breeding period, they leave the reserve to breed outside, on private ranches around (Armonia's Observations). They will come back at the end of the breeding season, with their young. Another study that I've done showed that they come back in high number

around the 15th of May. So the question is “how they can use the nest boxes if they leave the reserve?” We have seen during the monitoring that at the end of the breeding season, Blue-Throated macaws have been seen resting at some Rio Tiniji’s islands. So they can adjust to the nest boxes, trying them, during this period and so not leave the reserve to breed inside the nest boxes. This is the first problem to face because outside the reserve, they are more exposed to poachers. Secondly, after many years of cattle ranching, the reserve has to face lack of motacu palm trees. An unpublished study of Armonia has shown a high decrease of the regeneration of motacu. This has an impact on the fruit production, the principal source of food for the Blue-Throated macaw. Moreover, this study has shown that cattle ranching has logged all the old growth trees, and cut out most of the larger trees. No potential breeding natural cavities have been found. But seeing the importance of these palm forest islands as roosting sites, secured the idea that the macaws know these sites as safe, and if we were able to offer large nesting cavities, it is very possible the Blue-throated Macaws will nest on the reserve.

The nest box program initiated in 2014 at the BANR, on Rio Tiniji’s forest islands provides huge hope for the recovery of the Blue-Throated macaw. This year was the first year of monitoring and no macaw used nest, this will take time for them to adjust to the nest boxes. This first year was important to establish the monitoring’s technique and also for BTM to maybe recognize boxes as nests sites. The next years will show us if this program is a success or not. Finally, a little anecdote, this is the first time for the BANR that a Barn owl’s birth is recording showing that the reserve is a sanctuary for wildlife.

Interest of nest boxes program

The use of nest boxes is a widespread technique using in the conservation of birds’ species and the results are often convincing. This is the case for parrots species like the Hyacinth macaw *Anodorhynchus hyacinthinus* (Guedes, 1993), the scarlet macaw *Ara macao* (Olah, 2014, Vaughan 2003) or *Amazona* parrots (White, 2005). All these species saw their populations grow with the help of nest boxes programs. Nest boxes programs have shown their usefulness in the recovery of birds’ population. In addition to their utility in growing population size, nest boxes have other advantages. They are always dedicated to one target species, but we have seen on this study that other species can use the nest boxes like White eyed parakeet or Black-bellied Whistling Duck. So, nest boxes can help the nesting of different species in area where natural nest

cavities are hard to find (Warakai & al. 2013). Then, from a practical point of view, nest boxes are really amenable and can facilitate experimental manipulation, improving accessibility to the nest. Nest boxes also reduce variation in nesting circumstances like predation, parasites or poaching thanks to the design (Villard & Pärt 2004). For further studies, electronic monitoring devices (camera, sensors) can be put inside nest boxes to allow easiest monitorings (White & Vilella 2004). So, behavioral, morphological and long-terms studies can be done more easily with the monitoring of nest boxes than with natural cavities (Vigo & al. 2011). Furthermore, nest boxes can enhance the ecotourism by increasing the numbers of nesting birds in an area. Lots of tourists want to see healthy parrot populations in huge flocks and for that they are agree to pay. The important economic returns this creates can help local populations and birds conservation (Nycander & al. 1995, Hesse & Duffield 2000, Brightsmith & al. 2008). Nest boxes utility in enhancing ecotourism has been successfully tested in the Manu & Tambopata national parks in Peru (Munn 1992).

We have seen that nest boxes programs are effective for numerous species and this is the case for the program leading by Armonia for the Blue-Throated macaw. The southern part of this program has shown great success and there is hope for the northern part. But nothing is perfect, and lots of things are planned to improve the two programs in the future. For the southern part, we have seen that all the births in the 3 previous years were located in three areas. So Armonia have chosen to pool all the nest boxes in these 3 ranches for the upcoming breeding season to raise the chance to have more births in these areas. Explorations are also planned with the aim to discover new flocks and new potential sites to place nest boxes. For the nest boxes program at the BANR, different things are intended. Firstly, Armonia wants to create artificial islands on the Rio Tiniji where nest boxes could be placed to give more space and nest sites for the Blue-Throated macaw. This creation of islands combined with a reforestation project is in mind to increase motacu's presence to provide more food, roosting, resting and nesting sites. The goal is to make the Blue-Throated macaw stay at the reserve the whole year, even in the breeding season. Concerning the monitoring, instead of using a ladder to access nests, Armonia wants to establish a "single rope ascending" technique (Perry 1978, Perry & Williams 1981). This technique will allow Armonia to go on sites by canoe and not inevitably by horseback and so to do the monitoring more often, even in high rainy period. Furthermore, Armonia wants to make boxes directly in motacu's trunks.

The aim is that nest boxes can be the more natural possible, with wood that Blue-Throated macaw usually use, and also with a round shape like a trunk. Maybe with that, macaws will need less time to adjust to these nests. Finally, a GPS tracking program could be really interesting to monitor movement's patterns done by reproductive pairs. This could be helpful to know where they usually go in breeding season to place nest boxes there.

Conclusion

The two nest boxes programs leading by Armonia had opposite results: As expected, the southern part of the program is still successful with 10 new births this year. The 3 last years studied allow us to learn new parameters about breeding behaviour, a field which is remaining unknown for this species. Contrary, for the northern part, no nest box welcomed Blue-Throated macaw this year, but this results was planned because the program was only established this year. But hope is here for the future. Coming years of monitoring will show us if these programs can have an important impact on population size. Armonia is doing hard work to protect this amazing macaw from extinction. A hope of a recovery of the Blue-Throated macaw is still there.

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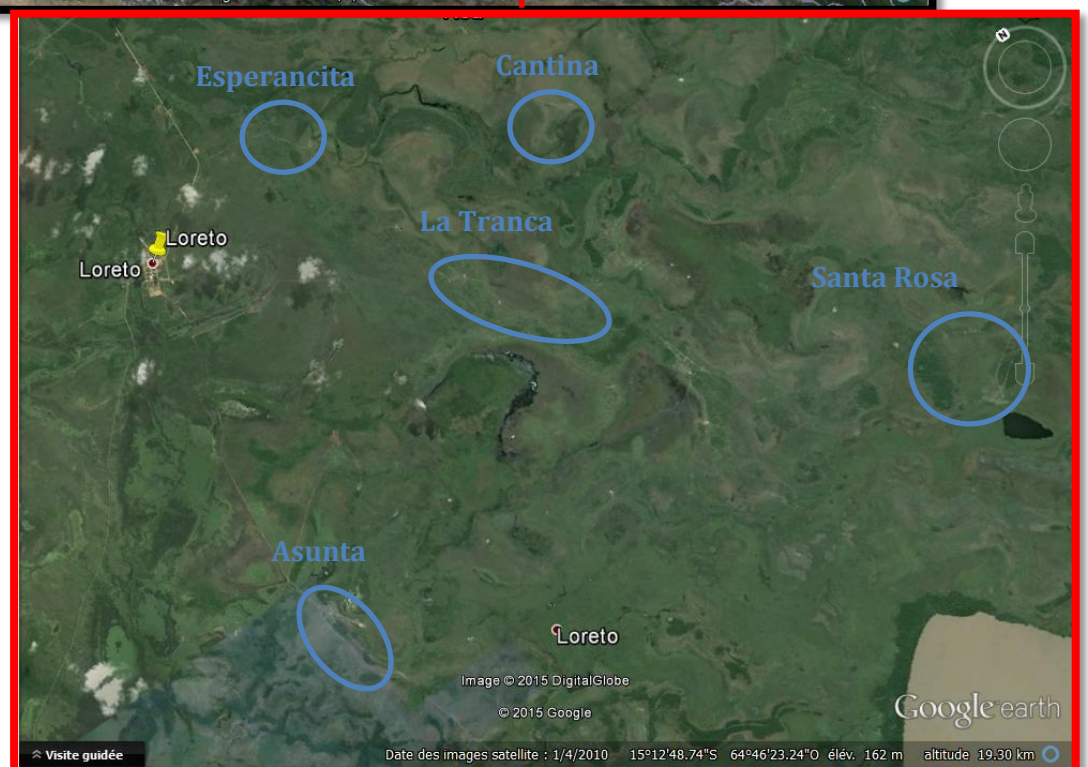
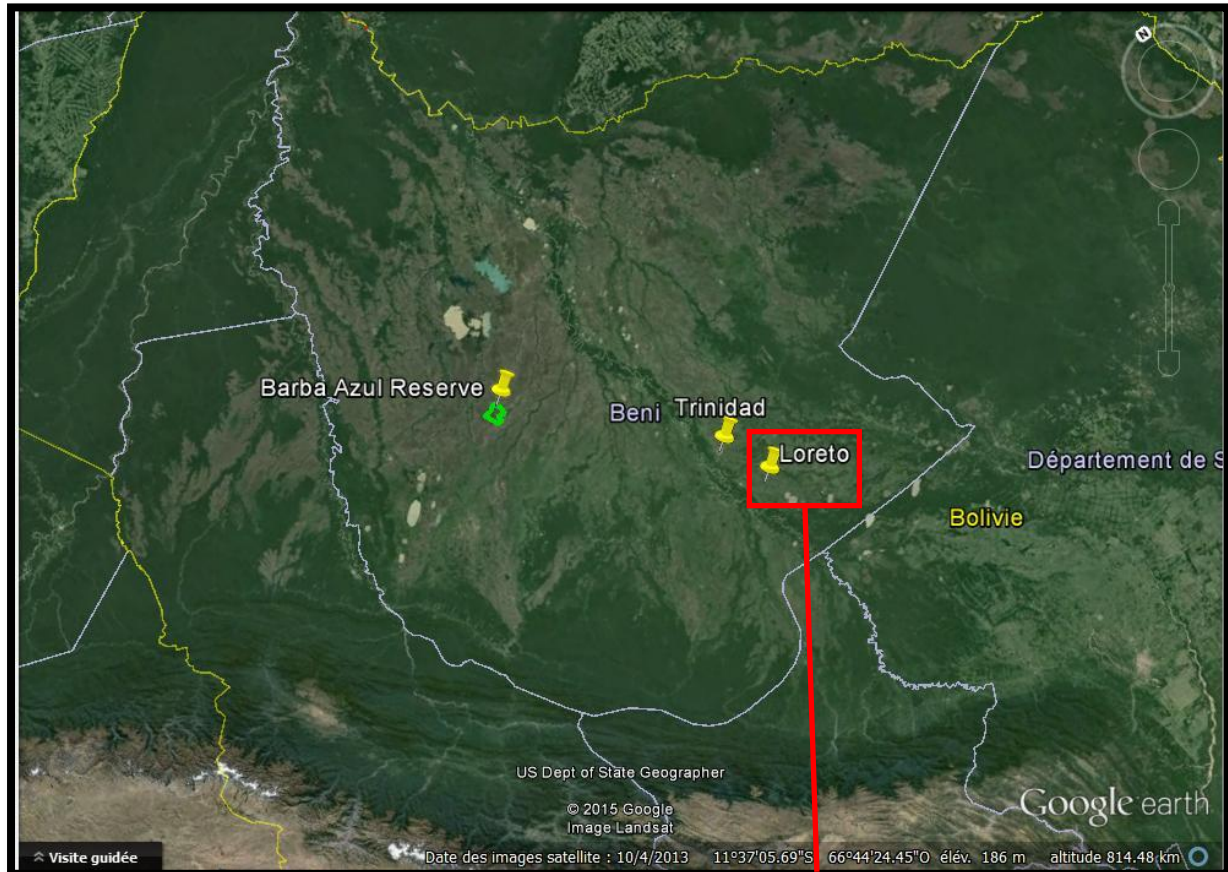
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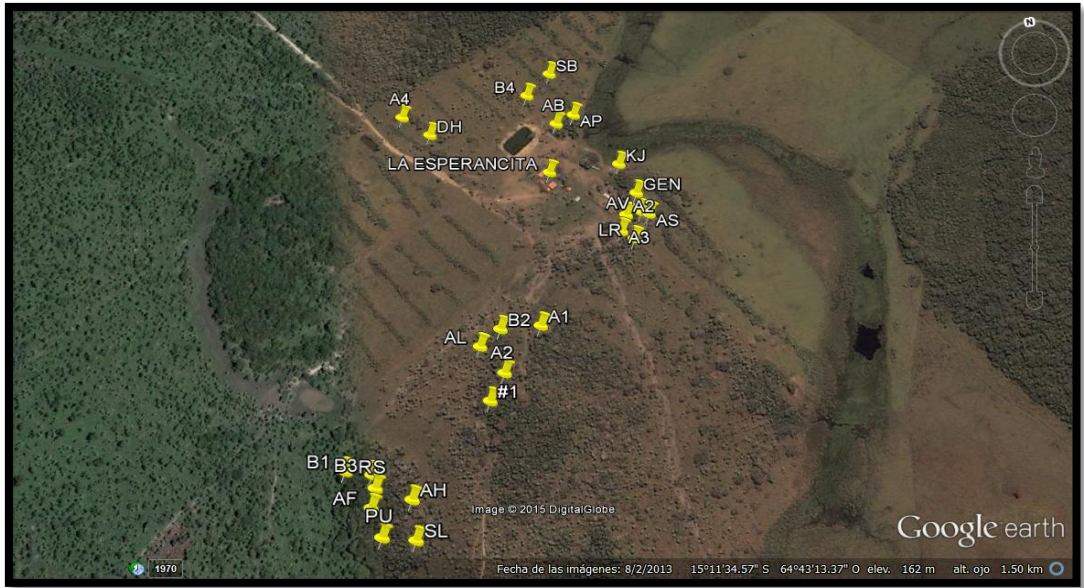
Annexe

Annex1: Nest Boxes Locations in the area of Loreto

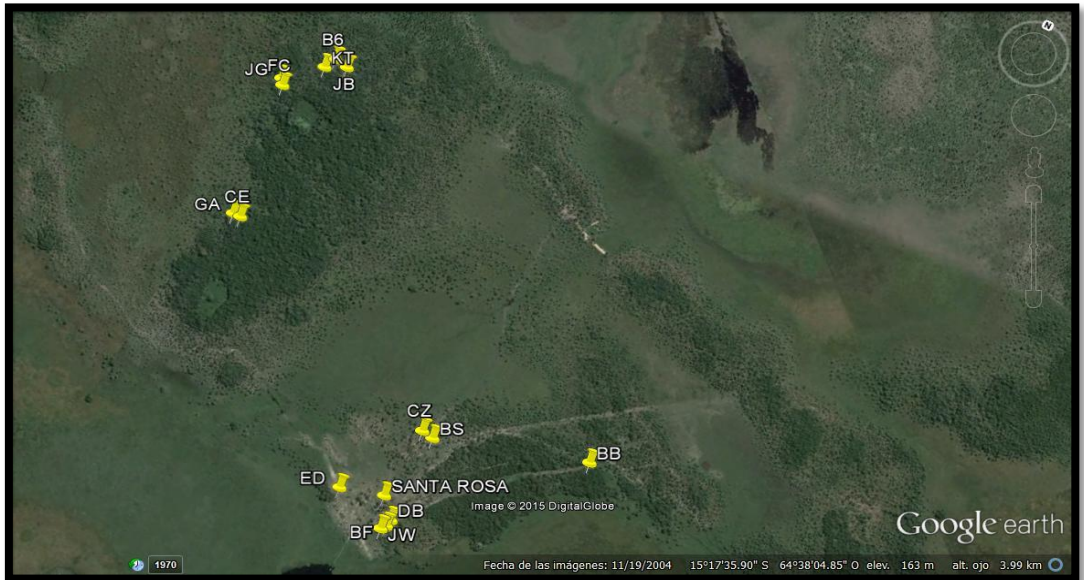


Location of the 5 ranches which welcomed nest boxes in 2015

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The 25 nest boxes located in « Esperancita »



The 14 nest boxes located in « Santa Rosa »



The 10 nest boxes located in « Cantina »

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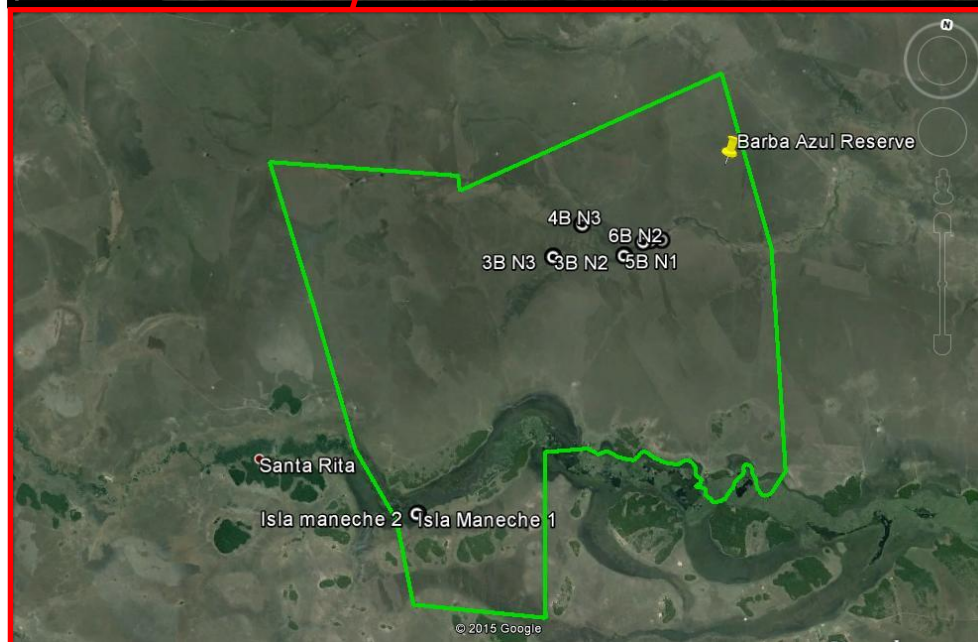
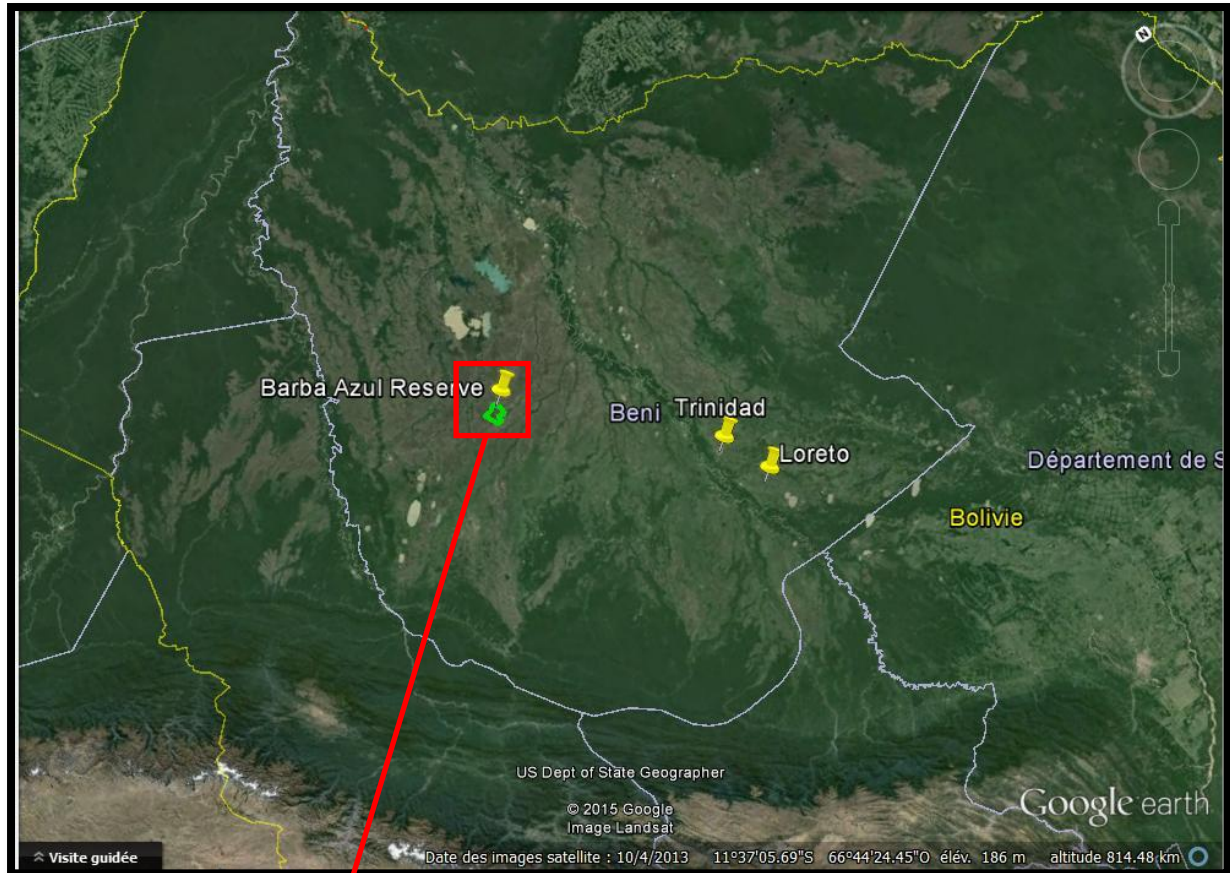


The 7 nest boxes located in « La Asunta »



The 4 nest boxes located in « La Tranca »

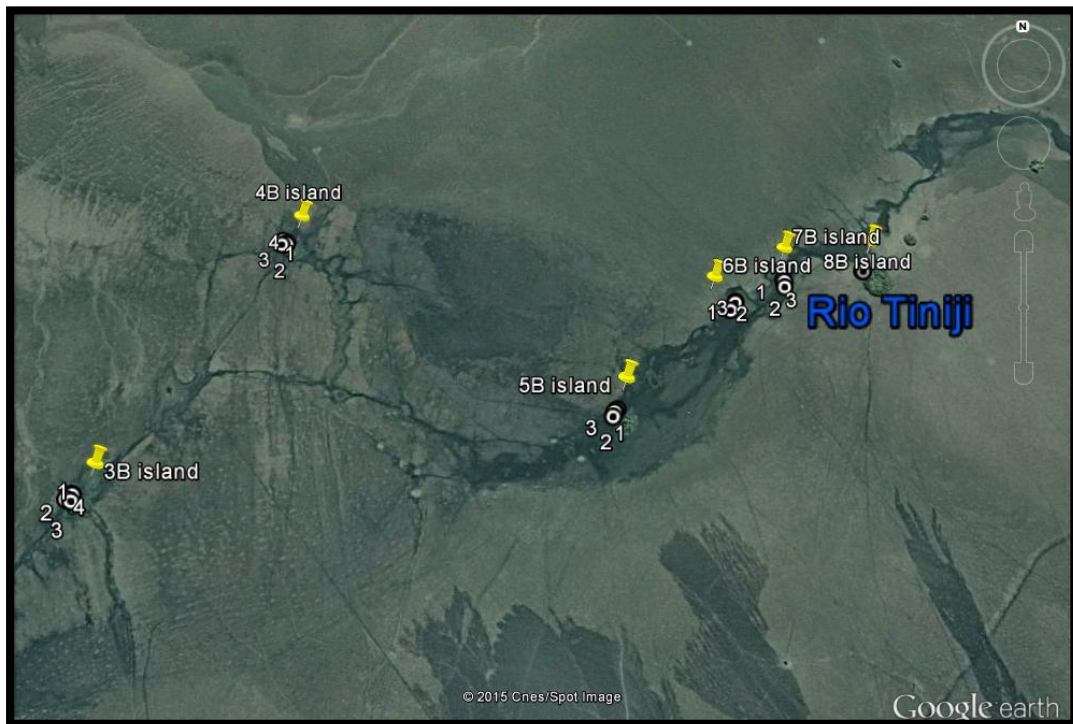
Annex2: Nest Boxes Locations at the Barba Azul Nature Reserve



Nest Boxes at the BANR : 20 nest boxes are located on islands along the Rio Tiniji (north) and 2 nest boxes on the Isla Maneche (south)



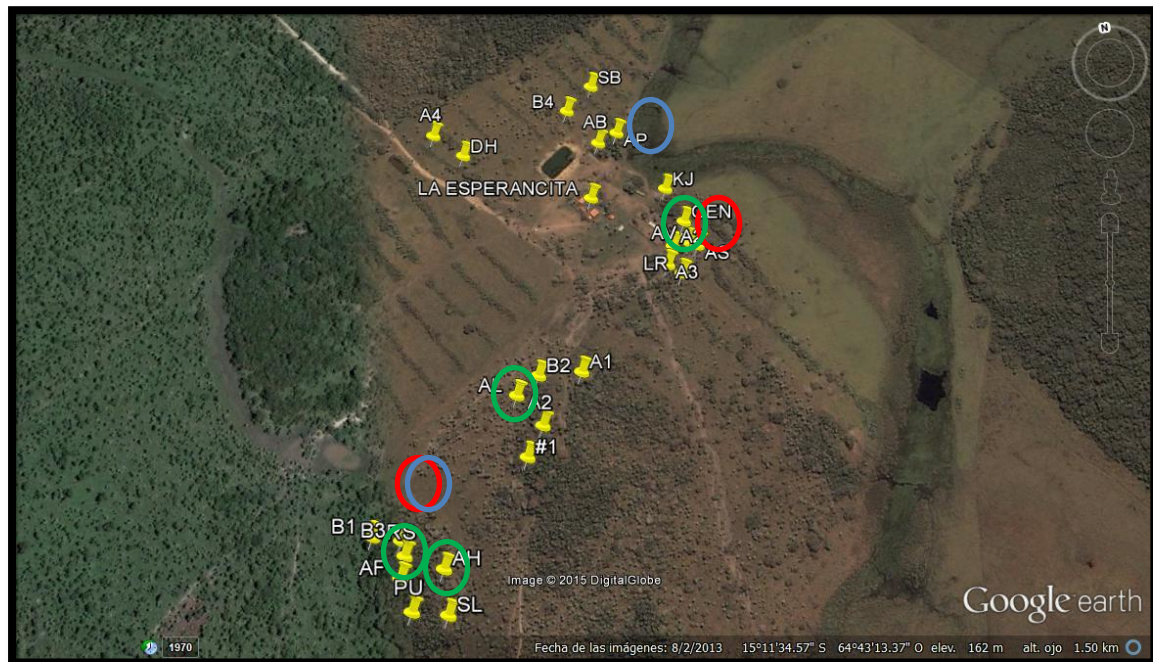
The 2 nest boxes located on the «Isla Maneche »



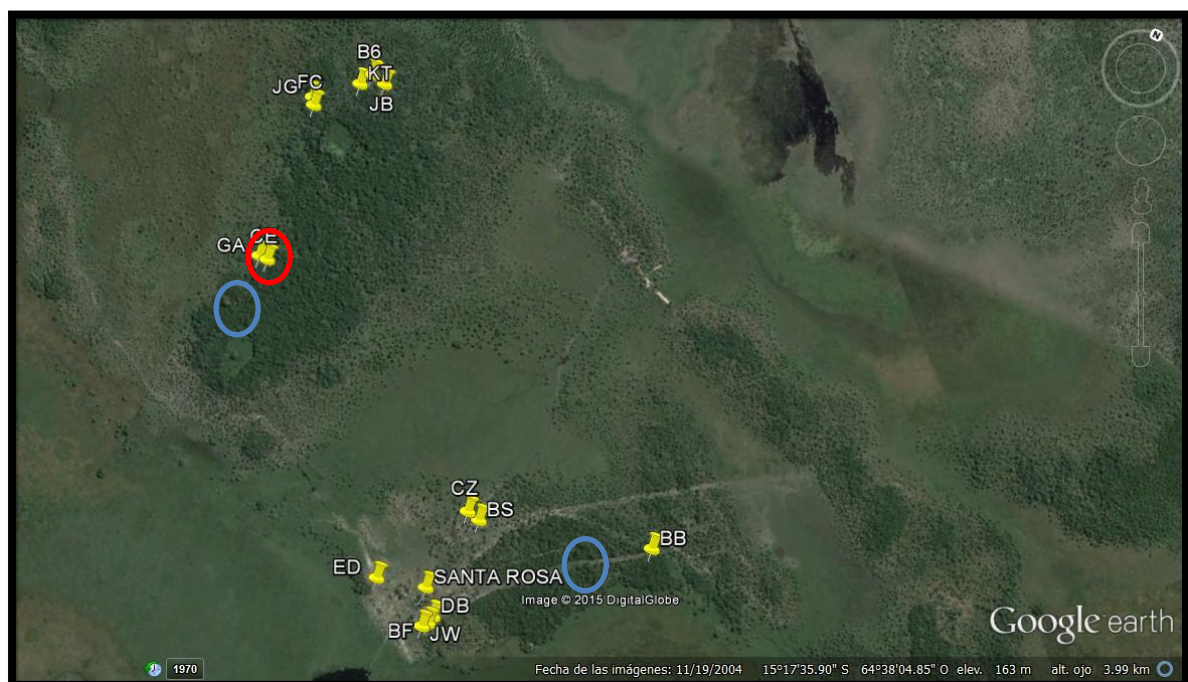
The 20 nest boxes located on islands along the Rio Tiniji : 4 on 3B island, 4 on 4B island, 4 on 5B island, 3 on 6B island, 3 on 7B island and 2 on 8B island.

Annex3: Nest boxes used by Blue-Throated macaw in the area of Loreto during the 3 last breeding seasons.

Three ranches welcomed successful nest boxes during the 3 last breeding seasons: Esperancita, Santa Rosa y Cantina. The red rounds are the nest boxes used in 2012-2013, the blue rounds were used in 2013-2014 and the green ones were used this year.

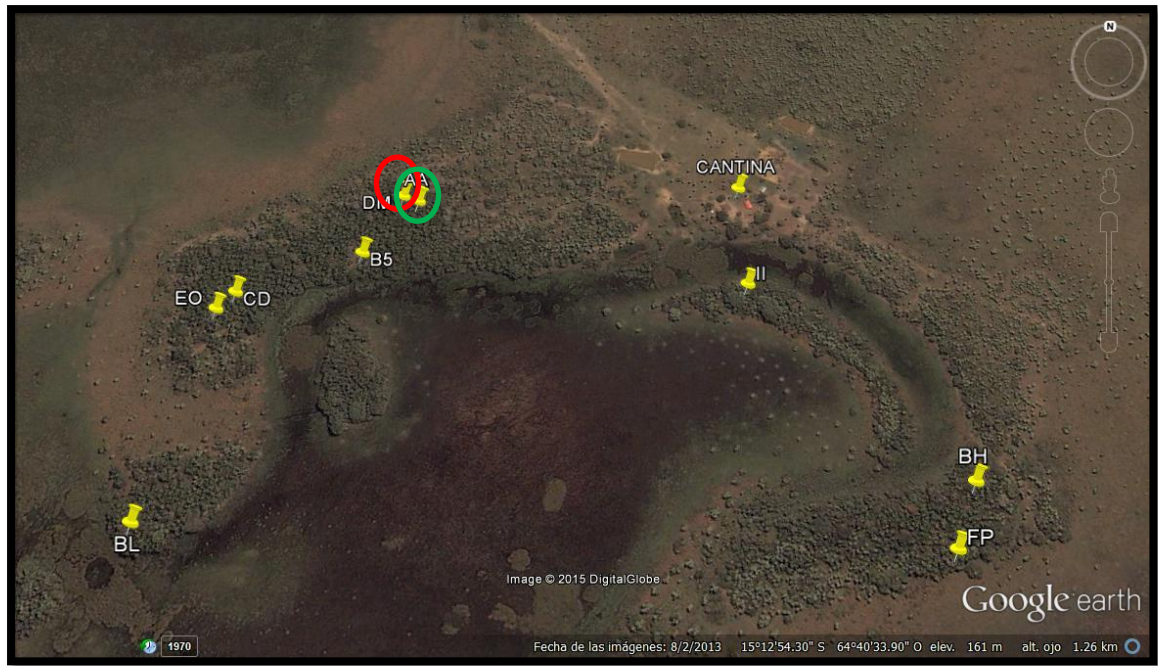


Nest boxes used in Esperancita



Nest Boxes used in Santa Rosa

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Nest Boxes used in Cantina

Annex4: Development of the young Blue-Throated macaws born inside nest boxes in the area of Loreto, breeding season 2015.



Nest Box PBA9 (RS) in Esperancita



Nest Box PBA35 (AA) in Cantina

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Nest Box PBA54 (GEN) in Esperancita



Nest Box PBA56 (AL) in Esperancita



Nest Box PBA58 (AH) in Esperancita. Unfortunately the 2 eggs didn't hatch.

Abstract

The Blue-Throated macaw (*Ara glaucogularis*) is an endemic parrot of the Beni department in Bolivia. Considered as “critically endangered” by the IUCN, this parrot has to face many threats like deforestation, poaching for the pet trade, use of its feathers for traditional clothes or lack of nesting cavities. Its population is estimated between 350 and 500 individuals divided in two sub-populations. Since 2005, asociacion Armonia is leading a vast conservation program on the Blue-Throated macaw with the aim to protect this bird and its habitat and with the hope of a recovery of the species in the wild. Armonia is one of the most important associations for bird protection in Bolivia, being the partner of world organizations like the LoroParque Fondation, Birdlife International or World Land Trust.

In addition to the creation of a protected reserve, Armonia leads two nest boxes program located in the two sub-populations: the first in the south of Trinidad, the main city of the Beni department, in the area of Loreto and the second north of Trinidad, in the Barba Azul Nature Reserve. The first program was established in 2005 and today it owns 60 nest boxes. In the two last previous years, this program was successful with respectively 10 and 7 successfully flying young Blue-Throated macaws. The second program was established in 2014 with 20 new nests boxes placed on peaceful islands along the Rio Tiniji.

The nest boxes monitoring that I perform this breeding season was successful once again in the Loreto’s area with 10 young born in the nest boxes. For the northern part of the program, no nest boxes welcomed Blue-Throated macaw’s pair. Like it was the first breeding season that the nest boxes were present, the result was predicted and this first year was useful for the recognition of nest boxes as potential breeding sites for the Blue-Throated macaws.

Finally, the hard work done by Armonia is at this time a success and give hope for a recovery of the Blue-Throated macaw in Bolivia.

Résumé

L'ara à gorge bleue ou ara canindé (*Ara glaucogularis*) est une espèce de perroquet endémique du département du Beni, au nord de la Bolivie. Considéré comme « en danger critique d'extinction » par l'UICN, cet ara doit faire face à de nombreuses menaces à sa survie : déforestation, braconnage, utilisation de ses plumes pour la confection d'habits traditionnels ou encore le manque de site de nidification. A l'heure actuelle, sa population est estimée entre 350 et 500 individus divisés en 2 sous-populations. Depuis 2005, l'ONG bolivienne Armonia mène un programme de conservation de l'ara à gorge bleue avec comme objectif la protection de cette espèce et son habitat, tout en favorisant la reproduction. Armonia est une des associations les plus importantes de Bolivie en ce qui concerne la protection des oiseaux et elle est partenaire d'organisations mondialement reconnues comme la LoroParque fondation, Birdlife Internationale ou encore World Land Trust.

Afin de protéger ce perroquet, outre la création d'une réserve protégée, Armonia a mis en place deux programmes de nids artificiels, localisés dans les deux sous-populations : Le premier se trouve dans la région de Loreto, au sud de Trinidad, capitale du Beni. Ce programme a été mis en place en 2005 et possède aujourd'hui 60 nids. Les deux dernières années de monitoring ont été couronnées de succès avec respectivement 10 et 7 jeunes qui se sont envolés des nids artificiels. Le second programme a été mis en place plus récemment à la réserve naturelle Barba Azul. L'agrandissement de la réserve en 2014, a permis à Armonia de placer des nids sur des îles du Rio Tiniji. C'est ainsi que 20 nids ont trouvé leur place dans ces îles paisibles et idéales pour la reproduction du Ara canindé.

Le monitoring des nids que j'ai effectué cette année à une nouvelle fois été fructueux pour le programme de Loreto, avec 10 nouveaux jeunes qui se sont vus le jour dans les nids artificiels. A la réserve, aucun des nouveaux nids n'a été visité par les aras, ce qui était plus ou moins prévu. Les nids étaient disponibles pour la première fois et les aras ont besoin de plus de temps pour reconnaître ces nids comme de véritables sites de nidification.

Finalement, le travail effectué par Armonia est fructueux et porteur d'espoir pour un avenir radieux de l'ara à gorge bleue.

